United States Department of the Interior
Fish and Wildlife Service
Bureau of Sport Fisheries and Wildlife

PRE-HUNTING-SEASON BANDING OF MALLARDS AND BLACK DUCKS

Progress Report, 1959 and 1960

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ABSTRACT

Progress made in the pre-hunting season mallard and black duck banding program in 1959 and 1960 was summarized. Samples banded at most locations were too small to yield reliable results and pre-season populations in Canada were very poorly represented. Other factors influencing the effectiveness of pre-season banding are discussed; these include accuracy of age determinations, the representativeness of ducks banded on refuge areas, and the effects of band collecting activities. A comparison of direct recovery rates in 1959 and 1960 indicated that the rate of kill did not differ significantly between years. Regional and annual differences in the relative recovery rates of immatures and adults were apparent from examination of the larger banded samples. Adults frequently were more likely to be shot than immatures in southern areas; immatures often were subjected to heavy hunting pressure near the banding stations. Pre-season banding data were used with information from the Mail Questionnaire Survey and Wing Collection Survey to estimate the size, age composition and harvest rate of the pre-season mallard population associated with the Mississippi Flyway.

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INTRODUCTION

A continent wide pre-hunting season banding program was begun in 1959 in an effort to measure the shooting pressure to which each age and sex component in the pre-season population is subjected. To do this, adequate samples of birds must be banded at each of a number of banding stations distributed across northern United States and southern Canada. Because of the similarity of arrangement between this network of banding stations and the network of radar stations spaced across Canada, this banding project has been called the "D. E. W. Line" banding program (Distant Early Warning). Some pre-season banding has been done in the past, but not as an organized effort across the continent; these earlier data were not available for this report because they were involved in the reconstruction of the damage caused by the fire at Patuxent in June 1959. This report outlines the objectives of the program and summarizes the results from the banding of mallards and black ducks in 1959 and 1960. It also includes a discussion of the problems and difficulties associated with the program. Examples are given to show how the data can be used in measuring the size, age composition and harvest rates of the pre-season duck population.

OBJECTIVES OF PRE-SEASON BANDING

The banding of flying adults and immatures shortly before the hunting season opens provides the best source of information on the following subjects:

1. Annual rates of hunting kill.

2. Mortality rates.

3. The importance of hunting as a mortality factor.

4. The relationship between hunting regulations and the proportion of the waterfowl population harvested.

5. The relative degree to which the various ages, sexes, and species are taken by hunting.

Mortality due to hunting is measured most reliably from pre-season banding because ducks banded at other times of the year are affected to a greater extent by non-hunting season mortality. Pre-season banding may have one serious limitation, however. At present no population surveys are made at this time, and if the data prove to be highly variable, interpretation of the results will require that the size

of populations represented by the banded samples be determined.
Information on the extent to which immature ducks are more likely
to be shot than adults is necessary for the determination of age
ratios in the population from age ratios in the kill.

The term relative recovery rate is used to express the degree to
which one component in the population (in this case immatures) is more
likely to be bagged than another component (adults).

Relative recovery rates are calculated by dividing the direct
recovery rate of immatures by the direct recovery rate of adults.
A relative recovery rate of 1.50 indicates that the immature portion
of a banded sample is 1-1/2 times as likely to be shot as the adult
portion. This rate can be based on either all recoveries or on those
from a particular harvest area. Relative recovery rates relate to
the population at the time of banding and not to the individuals of
each age group that are present in a given harvest area.

The term relative recovery rate is used here instead of the
term relative vulnerability rate as used by Bellrose et al. (1961)
in order to restrict the latter term to a precise meaning; that
characteristic of waterfowl such that when exposed to the same
hunting pressure, one kind (immatures) will have a higher probability
of being killed than will another kind (adults). The closer that the
banding is to the time and place of recovery, the closer the recovery
rates will reflect relative vulnerability, but as time passes, the
selective kill or differential migration of an age group may change
the age composition of the population available in an area. Thus, if
a disproportionately large proportion of the immatures is harvested
in a northern region, then in some southern region the recovery rate
for immatures may become less than that for adults (and the relative
recovery rate less than one) simply because fewer immatures have
survived to reach the southern region. At the same time, additional
age and experience may cause the immatures to become less vulnerable
and further the decrease in the relative recovery rate. Bellrose et
al. (1961) demonstrated how banding data could be used to estimate
the extent to which immatures are more likely to be shot than adults,
and discussed the factors which influence this difference.

RESULTS IN 1959 AND 1960

The numbers of mallards and black ducks banded and their direct
recovery rates are shown in tables 1 and 2. Only birds banded during
July, August, September, and October, prior to the hunting season in
the State or Province of banding, are included. Ideally, pre-season
banding should be completed before hunting begins in any area in
which the banded birds might be shot. Thus, banding at stations in

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the United States that are adjacent to Canada should be completed
before the opening of the Canadian hunting season. However, in
order to have larger samples available for analysis, pre-season
bandings in the United States were included even though hunting
had begun in adjacent areas of Canada. Relatively few Canadian
recoveries were obtained from pre-season bandings in the United
States.

Only direct recoveries (those occurring during the first hunting
season following banding) are listed in tables 1 and 2. Since the
objectives of pre-season banding relate to the hunting kill, only
ducks believed to be shot were included. In addition to recoveries
reported as shot, those reported as found dead during the hunting
season were used, because these also usually reflect shooting mor-
tality. Banded samples that yielded fewer than five recoveries in
each age group each year were grouped by State or Province. Data
from States or Provinces having no major banding location and a
small combined total from miscellaneous locations were omitted. A
single location includes all bandings in a 10' block of latitude
and longitude which is an area of approximately 8 x 12 miles in the
northern United States and southern Canada.

Adequacy of the Sample

The size of banded samples to be attained in the pre-season
program is defined in the Continental Banding Program (U. S. Fish
and Wildlife Service, 1959) as follows: "Sufficient birds should
be banded at each station to annually yield a minimum of 50 direct
recoveries from birds of the year and 50 from adults for each of
the important species. Since 100 direct recoveries from each of the
two age groups would allow for more accurate determination of differ-
ences in mortality from one station to the next, this figure will be
held as an objective." Only a few stations attained the minimum
recovery quotas. In 1959, Tule Lake National Wildlife Refuge in
California and Rice Lake National Wildlife Refuge in Minnesota were
the only stations to obtain 50 recoveries for each age group of
mallards. In 1960, no banding station attained these quotas for
mallards. No station or combination of adjacent stations reached
black duck quotas in either year. Station to station variability
in recovery rates and relative recovery rates cannot be accurately
evaluated because sample sizes are too small. Since a measure of
this variability is necessary in order to determine how well the
data reflect the characteristics of the entire pre-season population,
the objectives of the program were not fully attained. Much of the
apparent variability in tables 1 and 2 may be due to inadequate
samples rather than to true differences in the characteristics of
the populations being sampled.

The distribution of the sample also needs improvement. The distribution of banded samples should correspond to the distribution of the continental waterfowl population in August and early September. Considering what is known of the distribution of mallards at that period, it is apparent in table 1 that the Prairie Provinces of Canada were very poorly represented by the banding in 1959 and 1960. In order to attain the objectives of the pre-season banding program, it will be necessary to band more mallards in Canada and more black ducks in eastern Canada.

The accuracy of the age and sex determinations made at the time of banding also affects the reliability of pre-season banding information. It is known that immatures are more likely to be shot than adults. Since immatures had the higher direct recovery rate, it seems likely that most banders used reliable aging techniques. By late September some immature mallards and black ducks have molted their juvenile tail feathers. Therefore, all ducks with "adult" tail feathers must be aged by cloacal examination.

Band recovery rates will not give reliable information about the population if the banded birds are subjected to an atypically high or low shooting pressure. Most pre-season banding in the United States takes place on National Wildlife Refuges. There are little data available to evaluate the representativeness of refuge banding stations. In Minnesota, recovery rates from bandings at the Agassiz National Wildlife Refuge (formerly Mud Lake) and Thief Lake Refuge and Public Shooting Area offer an interesting comparison (table 1). The Agassiz Refuge consists of 60,000 acres and is entirely closed to hunting, while Thief Lake, approximately 10 miles away, contains 18,000 acres of which a large portion is used for public hunting. The similarity in recovery rates suggests that the protection from hunting provided by the Agassiz Refuge does not exert a pronounced effect on the recovery rates of ducks banded there in August and September.

The proportion of recovered waterfowl bands reported also is a variable that affects recovery rates. Organized band collecting near a pre-season banding station will distort recovery rates upward if banded birds remain near the trapping site until the hunting season opens. Since immatures usually are more vulnerable than adults near the banding site, relative recovery rates also will be affected by organized band collecting. In Oregon, the direct recovery rates of Sauvie Island and Summer Lake bandings (table 1) are unusually high in comparison to other locations. These high rates probably reflect heavy hunting pressure near the banding sites, but they also are influenced by band collecting to a degree that is difficult to measure.

Recovery Rates and Relative Recovery Rates

Table 3 presents direct recovery rates and relative recovery rates for mallards banded at the 10 stations having the largest banded samples in 1959 and 1960. Comparable information for black duck bandings at Perch Lake in New York also is included in this table.

Major hunting regulation changes between 1959 and 1960 consisted of a shift in the legal shooting hours from sunrise in 1959 to one-half hour before sunrise in 1960. This change affected all Flyways. In the Pacific Flyway, daily bag limits were reduced from five ducks to four in four States. Possession limits were reduced by two or more ducks in each of the seven States in the Flyway. In California, the daily bag limit was increased from five ducks in 1959 to six in 1960.

There were no pronounced changes in rate of kill that could be associated with changes in regulations (table 3). Including black duck recovery rates from Perch Lake bandings, the adult recovery rates increased in seven cases and decreased in four. Immature recovery rates also increased in seven cases and decreased in four. These changes suggest an increased rate of kill in 1960; they cannot be considered significant, however.

Recovery rates and relative recovery rates in table 3 indicate considerable variability among locations. If it could be assumed that the rates truly reflected the kill characteristics of pre-season populations at each banding station, and that these banding stations representatively sample the pre-season mallard population, then it would be possible to determine the number of stations required to reliably estimate recovery rates relating to the continental population. Some of the variability in table 3 can be attributed to sample size; some to band collecting activity. Lack of adequate pre-season banding in Canada leaves the representativeness of the locations open to question. It is hoped that in future years samples will be larger and their geographic distribution better so that a realistic appraisal of the required number of pre-season banding stations can be made.

Tables 4 through 10 present information on regional differences in relative recovery rates for those stations having sufficient bandings to examine in this way. Only Agassiz and Rice Lake National Wildlife Refuges had sufficient bandings for comparison of annual differences. Other rates in these tables were obtained by combining recovery information from 1959 and 1960. When recoveries from a banding station are divided into two or more harvest areas, the problem of sampling error becomes acute; therefore, estimates of relative recovery rates for a specific harvest area must be regarded as very imprecise.

The tables indicate that immatures are relatively more likely to be shot than adults in the vicinity of the banding station. Near the banding location, immatures were frequently more than twice as likely to be taken than adults, whereas in States to the south they were either slightly more likely (four locations) or less likely (five locations) to be bagged. These regional differences in relative recovery rates explain, in large measure, the regional differences in age ratios in the hunting kill that have been observed for mallards and black ducks (Geis and Carney, 1961). The occurrence of high relative recovery rates of immatures near the banding station was generally known; however, relative recovery rates lower than 1.00 in southern areas had not been expected.

As discussed earlier, relative recovery rates relate to the population of the time of banding and not to the population present in a specific harvest area. Thus, the relative recovery rate of 0.47 for black ducks banded at Perch Lake, New York and recovered in southern areas (table 4) means that immature black ducks banded at Perch Lake were only about one-half as likely to be shot in a southern area as the adults banded at Perch Lake during the same months. This does not imply that immature black ducks become more difficult to shoot than adults after both age groups reach the southern area. There are several possible explanations for relative recovery rates of less than 1.00 in southern areas. Since adults have a lower hunting mortality near the banding station than immatures, a plausible explanation is that a larger fraction of the pre-season adult population reaches southern areas. Also, as the hunting season progresses, immatures arriving in the South have become conditioned to shooting until their ability to avoid hunters is similar to that of adults.

Recoveries from bandings at Medicine Lake National Wildlife Refuge in Montana were divided into northern versus southern and Mississippi Flyway versus Central Flyway harvest areas (table 5). Relative recovery rates for northern and southern areas followed the typical pattern described previously. The division of Medicine Lake recoveries between Central and Mississippi Flyways resulted in a relative recovery rate of only 0.76 in the Central Flyway and 1.48 in the Mississippi Flyway. This difference was due to the larger proportion of the band recoveries from adults coming from the Central Flyway. The greater occurrence of immature recoveries in the Mississippi Flyway is consistent with the concept that immatures wander more than adults in late summer and fall.

Annual changes in regional relative recovery rates were examined for Agassiz and Rice Lake bandings (tables 6 and 7). Direct recoveries of immatures from Rice Lake and adults from Agassiz suggested that larger proportions of these two samples were killed in the central zone in 1960 than in 1959.

APPLICATION OF PRE-SEASON BANDING DATA TO OTHER WATERFOWL DATA

The pre-season banding data for 1959 and 1960 were used with data from the Wing Collection Survey and Mail Questionnaire Survey to estimate the age composition, harvest rate and size of the pre-season mallard population. Because of the weaknesses in the banding data, these estimates cannot be considered reliable; they are given here as examples of methods and to illustrate the potential value of such banding data.

Calculation of Pre-Season Age Ratios from Age Ratios in the Hunting Kill

Wing collections in the Mississippi Flyway during the 1959 and 1960 hunting seasons provided estimates of the mallard age ratios in the hunting kill. Pre-season banding provided estimates of relative recovery rates. Wing collections indicated 0.77 immature mallards per adult in the 1959 kill (Geis and Carney, 1961a), and 1.84 immatures per adult in the 1960 kill (Geis and Carney, 1961b). Average relative recovery rates for the Mississippi Flyway were 1.45 in 1959 and 1.42 in 1960 (table 11). Since this rate is an expression of the number of times immatures are more likely to be shot than adults, the pre-season age ratio can be estimated by dividing the age ratio observed in the kill by the relative recovery rate. Thus, for 1959, the estimate is 0.53 immatures per adult in the pre-season population (0.77 divided by 1.45) and for 1960 the estimate is 1.30 immatures per adult (1.84 divided by 1.42).

Estimate of Pre-Season Population Size

Data from pre-season banding, the Wing Collection Survey and the Mail Questionnaire Survey can be handled in several ways to yield population estimates (Carney and Geis, 1961). The method outlined in table 12 is a reasonable one, however, and will serve as an illustration.

The source of each number presented in table 12 is explained in the table, except for an additional quantity of ducks added at the end to adjust for mallards killed in Canada. The kill in Canada was not well represented by pre-season bandings because all but one of

the banding stations were in the United States. Only 11.3 percent
of the recoveries (each station weighted equally) were in Canada.
Unpublished information on the distribution of the mallard kill
between Canada and the United States indicates that approximately
35 percent of the kill is in Canada. Using this estimate, it appears
that 32 percent of the Canadian kill ($\frac{11.3}{35}$ x 100) was represented by
pre-season bandings in 1959 and 1960. Hunting kill rates shown in
table 12 reflect a 31 percent hunting kill (see next section), of
which 27.5 percent was in the United States, since 11.3 percent of
the total recoveries were in Canada. Since the kill in the United
States should reflect 65 percent of the total kill rather than
89 percent as the pre-season banding indicated, it was necessary to
add the additional Canadian kill indicated in table 12. It is not
known whether or not it is appropriate to add these birds to the
pre-season total. The key to the problem is whether or not pre-season
bandings largely in the United States truly reflect the total harvest
rate or whether the harvest rate is slightly low because of an un-
represented Canadian kill. The solution to this problem is more
adequate banding in Canada.

In spite of the shortcomings of the banding data, which must be
regarded as the weakest link in the chain of calculations outlined in
table 12, the estimated pre-season population levels are of a reason-
able magnitude. This estimate relates to the pre-season population
which is represented by the banded samples listed in table 11, and
these banding stations are associated with Central, Mississippi, and
Atlantic Flyway harvest areas.

Importance of Hunting as a Mortality Factor

If kill rates presented in table 12 truly reflect the kill in
the Mississippi Flyway, then a substantial hunting mortality occurred
in 1959 and 1960 despite comparatively restrictive regulations.
About 64 percent of the band recoveries from banding stations listed
in table 11 occurred in the Mississippi Flyway. The average harvest
rate in the Mississippi Flyway was 16 percent (average value from
table 12); therefore, the total kill rate for the population repre-
sented by these stations is 16 percent divided by 64 percent or 25
percent. If a crippling loss of 25 percent of the retrieved kill is
added, this indicates that 31 percent of the pre-season population
was harvested. Since all but one banding station was in the United
States, the Canadian kill was not properly reflected in the recoveries.
Therefore, the total harvest rate including the Canadian kill would
be about 40 percent.

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Table 1. Mallard Preseason Banding and Direct Recovery Rates[1], 1959 and 1960.

State or Province	Bander and Location	1959 Number Banded Ad.	Imn.	1959 Number Recovered Ad.	Imm.	1959 Direct Recovery Rate (Per cent) Ad.	Imm.	1960 Number Banded Ad.	Imm.	1960 Number Recovered Ad.	Imm.	1960 Direct Recovery Rate (Per cent) Ad.	Imm.
Wash.	State Game Dept.: Misc. Locations	205	97	16	11	7.8	11.3	41	151	3	33	7.3	21.8
	McNary NWR: At Refuge	78	70	7	5	9.0	7.1	100	33	7	3	7.0	9.1
	Columbia NWR: At Refuge							52	262	6	41	11.5	15.6
	Misc. Bandings Misc. Locations	13	4	1	1	(7.7)	(25.0)	25	7	1	0	(4.0)	(0.0)
Totals		296	171	24	17	8.1	9.9	218	453	17	77	7.8	17.0
Oregon	State Game Comm.: Summer Lake	154	129	28	53	18.2	41.1	137	157	13	41	9.5	26.1
	Sauvie Island	222	370	44	88	19.8	23.8	207	594	37	152	17.9	25.6
	Malheur NWR: At Refuge	65	29	0	1	0.0	3.4	214	302	12	19	5.6	6.3
	Misc. Bandings Misc. Locations	1	0	0	0								
Totals		442	528	72	142	16.3	26.9	558	1,053	64	212	11.5	20.1
Calif.	Div. of Fish & Game: Los Banos	349	1,002	27	98	7.7	9.8	11	32	1	5	(9.1)	15.6
	Tule Lake NWR: At Refuge	1,142	370	77	59	6.7	15.9	443	288	34	40	7.7	13.9
	Misc. Bandings Misc. Locations	4	1	1	1	(25.0)	(100.0)						
Totals		1,495	1,373	105	158	7.0	11.5	454	320	35	45	7.7	14.1

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Table 1. Mallard Preseason Banding and Direct Recovery Rates, 1959 and 1960. (Continued).

State or Province	Bander and Location	1959 Number Banded Ad.	Imm.	1959 Number Recovered Ad.	Imm.	1959 Direct Recovery Rate (Per cent) Ad.	Imm.	1960 Number Banded Ad.	Imm.	1960 Number Recovered Ad.	Imm.	1960 Direct Recovery Rate (Per cent) Ad.	Imm.
Idaho	Camas NWR: At Refuge	36	26	4	3	11.1	11.5	309	107	14	3	4.5	2.8
	Minidoka NWR: At Refuge	128	38	8	3	6.2	7.9	71	111	3	5	4.2	4.5
	Misc. Bandings: Misc. Locations							3	0	0	0	(0.0)	--
Totals		164	64	12	6	7.3	9.4	383	218	17	8	4.4	3.7
Utah	State Fish & Game: Clear Lake Refuge	41	55	3	6	7.3	10.9	77	235	4	16	5.2	6.8
	Ogden Bay Refuge	94	33	11	6	11.7	18.2	89	151	8	19	9.0	12.6
	Bear River Mig. Bird Ref.: At Refuge	48	0	6	0	12.5	--	6	0	1	0	(16.7)	--
Totals		183	88	20	12	10.9	13.6	172	386	13	35	7.6	9.1
Nevada	Ruby Lake NWR: At Refuge	16	19	1	3	(6.2)	(15.8)	272	43	21	2	7.7	4.6
	Fish & Game Comm.: Stillwater WMA	64	9	5	2	7.8	(22.2)	2	6	1	0	(50.0)	(0.0)
	Misc. Bandings Misc. Locations	2	0	0	0	(0.0)	--	2	2	0	0	(00.0)	(0.0)
Totals		82	28	6	5	7.3	17.8	276	51	22	2	8.0	3.9

Table 1. Mallard Preseason Banding and Direct Recovery Rates, 1959 and 1960 (Continued).

State or Province	Bander and Location	1959						1960					
		Number Banded		Number Recovered		Direct Recovery Rate (Percent)		Number Banded		Number Recovered		Direct Recovery Rate (Percent)	
		Ad.	Imm.	Ad.	Imm.	Ad.	Imm.	Ad.	Imm.	Ad.	Imm.	Ad.	Imm.
Sask.	Johnson & Nelson:												
	Last Mountain Lake	862	127	52	12	6.0	9.4	23	79	1	4	(4.4)	5.1
	James L. Nelson:												
	Near Tessier	53	24	1	1	1.9	(4.2)	25	126	3	13	(12.0)	10.3
	Near Wadena	51	31	2	1	3.9	3.2	0	33	0	5	--	15.2
	Near Iffley	29	59	1	2	3.4	3.4						
	W. J. Stephen Meadow Lake							20	52	1	7	(5.0)	13.5
	Alex Dzubin: Teo Lake (Smiley)	276	53	14	4	5.1	7.5	—	—	—	—	—	—
Totals		1,271	294	70	20	5.5	6.8	68	290	5	29	7.4	10.0
Montana:	Medicine Lake NWR:												
	At Refuge	276	51	18	6	6.5	11.8	371	681	18	37	4.8	5.4
	Bowdoin NWR:												
	At Refuge	1,106	237	36	9	3.2	3.8	577	264	31	9	5.4	3.4
	Ninepipe NWR:												
	At Refuge	108	101	4	14	3.7	13.9	513	514	30	54	5.8	10.5
	Misc. Bandings:												
	Misc. Locations	26	5	2	0	7.7	(0.0)	27	31	4	2	(14.8)	6.4
Totals		1,516	394	60	29	4.0	7.4	1,488	1,490	83	102	5.6	6.8

Table 1. Mallard Preseason Banding and Direct Recovery Rates, 1959 and 1960 (Continued).

State or Province	Bander and Location	1959						1960					
		Number Banded		Number Recovered		Direct Recovery Rate (Per cent)		Number Banded		Number Recovered		Direct Recovery Rate (Per cent)	
		Ad.	Imm.	Ad.	Imm.	Ad.	Imm.	Ad.	Imm.	Ad.	Imm.	Ad.	Imm.
Manitoba	Ducks Unlimited: Libau Marsh	235	401	18	46	7.6	11.5	102	368	8	62	7.8	16.8
	Delta Waterfowl Research Station: Delta	62	91	3	7	4.8	7.7	87	71	6	9	6.9	12.7
	Misc. Banding: Misc. Locations	6	31	2	2	(33.3)	(6.4)	0	3	0	1	--	(33.3)
Totals		303	523	23	55	7.6	10.5	189	442	14	72	7.4	16.3
N. Dakota	Des Lacs NWR: At Refuge	44	57	3	8	6.8	13.8	33	99	2	17	6.1	17.2
	Arrowwood NWR: At Refuge	5	12	1	5	(20.0)	(41.7)	2	23	0	4	(0.0)	(17.4)
	Lower Souris NWR: At Refuge	469	18	22	1	4.7	(5.6)	729	137	52	11	7.1	8.0
	Misc. Banding Misc. Locations							1	0	0	0	(0.0)	--
Totals		518	87	26	14	5.0	16.1	765	259	54	32	7.0	12.4
S. Dakota	Sand Lake NWR: At Refuge							617	394	51	28	8.3	7.1
Totals								617	394	51	28	8.3	7.1

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Table 1. Mallard Preseason Banding and Direct Recovery Rates, 1959 and 1960 (Continued).

State or Province	Bander and Location	1959						1960					
		Number Banded		Number Recovered		Direct Recovery Rate (Per cent)		Number Banded		Number Recovered		Direct Recovery Rate (Per cent)	
		Ad.	Imm.	Ad.	Imm.	Ad.	Imm.	Ad.	Imm.	Ad.	Imm.	Ad.	Imm.
Minnesota	Conservation Dept.:												
	Thief Lake Refuge	557	418	52	51	9.3	12.2	5	5	0	2	(00.0)	(40.0)
	Roseau Refuge	156	372	10	36	6.4	9.7						
	Agassiz NWR:												
	At Refuge	335	657	29	73	8.6	11.1	350	730	29	135	8.3	18.5
	Upper Miss. NWR:												
	Near Reno	15	43	0	6	(0.0)	14.0						
	Rice Lake NWR:												
	At Refuge	392	567	51	82	13.0	14.5	225	477	24	65	10.7	13.6
	Misc. Banding												
	Misc. Locations	26	36	3	6	11.5	16.7	3	0	0	0	(00.0)	--
Totals		1,481	2,093	145	254	9.8	12.1	583	1,212	53	202	9.1	16.7
Wisconsin													
	Upper Miss. NWR:												
	Gibbs Chute	12	35	5	7	(41.7)	20.0	0	34	0	4	--	11.8
	Marshland							4	42	3	6	(75.0)	14.3
	DeColon Chute							4	45	0	7	(00.0)	15.6
	Necedah NWR:												
	At Refuge							15	112	3	21	(20.0)	18.8
	Misc. Banding:												
	Misc. Locations	5	23	2	4	(40.0)	(17.4)	0	5	0	1	--	(20.0)
Totals		17	58	7	11	41.2	19.0	23	238	6	39	26.1	16.4

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Table 1. Mallard Preseason Banding and Direct Recovery Rates, 1959 and 1960 (Continued).

State or Province	Bander and Location	1959						1960					
		Number Banded		Number Recovered		Direct Recovery Rate (Per cent)		Number Banded		Number Recovered		Direct Recovery Rate (Per cent)	
		Ad.	Imm.	Ad.	Imm.	Ad.	Imm.	Ad.	Imm.	Ad.	Imm.	Ad.	Imm.
Ontario	Edward Kroll: Oshawa	51	152	6	24	11.8	15.8	17	125	1	17	(5.9)	13.6
	Misc. Banding Misc. Locations	1	51	0	4	(00.0)	7.8	0	20	0	4	--	(20.0)
Totals		52	203	6	28	11.5	13.8	17	145	1	21	5.9	14.5
Michigan	Kellogg Bird Sanc.: At Sanctuary	39	85	3	4	7.7	4.7	24	65	2	9	(8.3)	13.8
	Seney NWR: At Refuge	31	148	2	21	6.4	14.2	29	235	4	34	13.8	14.5
	Shiawassee NWR: At Refuge	22	347	1	42	(4.5)	12.1	93	665	7	102	7.5	15.3
	Misc. Banding Misc. Locations	10	8	1	2	(10.0)	(25.0)	2	9	0	1	(0.0)	(11.1)
Totals		102	588	7	69	6.9	11.7	148	974	13	146	8.8	15.0
Indiana	Dept. of Conservation: Willow Slough SGP	46	34	4	5	8.7	14.7	219	147	19	13	8.7	8.8
	Misc. Banding: Misc. Locations	8	34	0	1	(00.0)	2.9	0	1	0	0	--	(00.0)
Totals		54	68	4	6	7.4	8.8	219	148	19	13	8.7	8.8

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Table 1. Mallard Preseason Banding and Direct Recovery Rates, 1959 and 1960 (Continued).

State or Province	Bander and Location	1959						1960					
		Number Banded		Number Recovered		Direct Recovery Rate (Per cent)		Number Banded		Number Recovered		Direct Recovery Rate (Per cent)	
		Ad.	Imm.	Ad.	Imm.	Ad.	Imm.	Ad.	Imm.	Ad.	Imm.	Ad.	Imm.
Ohio	Misc. Banding: Misc. Locations							13	35	1	10	(7.7)	28.6
	Totals							13	35	1	10	(7.7)	28.6
Quebec	Misc. Banding: Misc. Locations							5	42	1	5	(20.0)	11.9
	Totals							5	42	1	5	(20.0)	11.9
New York	N.Y. Cons. Dept.:												
	Perch Lake	85	506	5	56	5.9	11.1	81	618	7	85	8.6	13.8
	Wilson Hill	36	89	1	13	2.8	14.6	48	44	3	9	6.2	20.4
	Howland Island	1	44	0	0	(00.0)	00.0	258	326	15	27	5.8	8.3
	Vischers Ferry	4	21	0	5	(00.0)	(23.8)	18	85	3	8	(16.7)	9.4
	Montezuma NWR: At Refuge							46	100	7	11	15.2	11.0
	Misc. Banding Misc. Locations	11	41	1	4	(9.1)	9.8	2	12	2	5	(100.0)	(41.7)
	Totals	137	701	7	78	5.1	11.1	453	1,185	36	144	8.0	12.1
Delaware	Bombay Hook NWR: At Refuge	180	62	7	1	3.9	1.6	271	378	6	22	2.2	5.8
	Totals	180	62	7	1	3.9	1.6	271	378	6	22	2.2	5.8
Vermont	Fish & Game Service: Dead Creek	11	100	2	15	(18.2)	15.0	34	161	3	21	8.8	13.0
	Misc. Banding: Misc. Locations	1	35	0	3	(00.0)	8.6	5	18	2	2	(40.0)	(11.1)
	Totals	12	135	2	18	(16.7)	13.3	39	179	5	23	12.8	12.8

1/ Rates derived from samples of 25 ducks or less are in parentheses.

Table 2. Black Duck Preseason Banding and Direct Recovery Rates, 1959 and 1960.

State or Province	Bander and Location	1959						1960					
		Number Banded		Number Recovered		Direct Recovery Rate (Per cent)		Number Banded		Number Recovered		Direct Recovery Rate (Per cent)	
		Ad.	Imm.	Ad.	Imm.	Ad.	Imm.	Ad.	Imm.	Ad.	Imm.	Ad.	Imm.
New Brunswick	Bruce Wright & Donald Reid:												
	McAdam	84	394	6	35	7.1	8.9	17	357	1	28	(5.9)	7.8
Totals		84	394	6	35	7.1	8.9	17	357	1	28	(5.9)	7.8
Quebec	P. Harvey:												
	Baie Johan Beetz	24	117	1	3	(4.2)	2.6	50	152	1	15	2.0	9.9
	Gaston Moisan:												
	St. Angele de Laval							47	203	3	29	6.4	14.3
	Misc. Banding:												
	Misc. Locations	3	10	0	0	(00.0)	(00.0)						
Totals		27	127	1	3	3.7	2.4	97	355	4	44	4.1	12.4
Ontario	Robert Catton:												
	Patawawa Goose Sanc.	11	72	2	8	(18.2)	11.1						
	Edward Kroll:												
	Oshawa	95	332	6	47	6.3	14.2	42	168	2	21	4.8	12.5
	E. H. Stone:												
	Halliday Lake							27	131	4	10	14.8	7.6
	Misc. Banding												
	Misc. Locations	5	29	0	3	(00.0)	10.3	2	27	0	1	(00.0)	3.7
Totals		111	433	8	58	7.2	13.4	71	326	6	32	8.4	9.8
New Hampshire	Howard Brown:												
	Errol	20	82	0	8	(00.0)	9.8	13	137	1	24	(7.7)	17.5
Totals		20	82	0	8	(00.0)	9.8	13	137	1	24	(7.7)	17.5

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Table 2. Black Duck Preseason Banding and Direct Recovery Rates, 1959 and 1960 (Continued).

State or Province	Bander and Location	1959						1960					
		Number Banded		Number Recovered		Direct Recovery Rate (Per cent)		Number Banded		Number Recovered		Direct Recovery Rate (Per cent)	
		Ad.	Imm.	Ad.	Imm.	Ad.	Imm.	Ad.	Imm.	Ad.	Imm.	Ad.	Imm.
Vermont	Fish & Game Service:												
	Dead Creek Area	17	342	3	34	(17.6)	9.9	10	305	1	31	(10.0)	10.2
	Button Bay Area	3	99	1	12	(33.3)	12.1	3	22	0	1	(00.0)	(4.5)
	So. Bay, Newport	8	76	2	13	(25.0)	17.1	14	191	2	17	(14.3)	8.9
	Berlin Pond, Berlin	4	83	0	12	(00.0)	14.5	6	86	1	16	(16.7)	18.6
	Misc. Bandings:												
	Misc. Locations	0	22	0	3	--	(13.6)	21	35	2	3	(9.5)	8.6
Totals		32	622	6	74	18.8	11.9	54	639	6	68	11.1	10.6
Mass.	Parker River NWR:												
	At Refuge							56	0	7	0	12.5	--
	Great Meadows NWR							17	29	1	5	(5.9)	17.2
Totals								73	29	8	5	11.0	17.2
New York	Cons. Department:												
	Vischers Ferry	17	95	0	13	(00.0)	13.7	2	12	0	1	(00.0)	(8.3)
	Perch Lake	91	626	6	62	6.6	9.9	96	524	11	71	11.5	13.6
	Wilson Hill	99	374	8	44	8.1	11.8	157	282	24	51	15.3	18.1
	Howland Island							155	107	10	10	6.4	9.3
	Misc. Bandings:												
	Misc. Locations	7	44	1	8	(14.3)	18.2	59	86	3	8	5.1	9.3
Totals		214	1,139	15	127	7.0	11.2	469	1,011	48	141	10.2	14.0
Maine	Misc. Bandings:												
	Misc. Locations	7	86	1	3	(14.3)	3.5	11	33	1	4	(9.1)	12.1
Totals		7	86	1	3	(14.3)	3.5	11	33	1	4	(9.1)	12.1

Table 2. Black Duck Preseason Banding and Direct Recovery Rates, 1959 and 1960 (Continued).

State or Province	Bander and Location	1959						1960					
		Number Banded		Number Recovered		Direct Recovery Rate (Per cent)		Number Banded		Number Recovered		Direct Recovery Rate (Per cent)	
		Ad.	Imm.	Ad.	Imm.	Ad.	Imm.	Ad.	Imm.	Ad.	Imm.	Ad.	Imm.
Mich.	Dept. of Conservation: near Bear Lake	3	22	0	8	(00.0)	(36.4)						
	Seney NWR: at Refuge	36	146	0	15	00.0	10.3	24	166	0	24	(00.0)	14.5
	Shiawassee NWR: at Refuge	6	76	0	4	(00.0)	5.3	12	86	2	14	(16.7)	16.3
	Misc. Bandings: Misc. Locations	4	37	0	3	(00.0)	8.1	10	34	0	2	(00.0)	5.9
Totals		49	281	0	30	00.0	10.7	46	286	2	40	4.4	14.0
Minn.	Rice Lake NWR: at Refuge	76	71	11	12	14.5	16.9	5	23	2	5	(40.0)	(21.7)
	Misc. Bandings: Misc. Locations	25	33	2	4	8.0	12.1	4	4	0	0	(00.0)	(00.0)
Totals		101	104	13	16	12.9	15.4	9	27	2	5	(22.2)	18.5

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Table 3. Mallard[*] Direct Recovery Rates and Relative Recovery Rates for All Harvest Areas Based on Banding Locations Having Largest Banded Samples in 1959 and 1960[**].

Banding Location	Number Banded				Direct Recovery Rate (Per cent)				Relative Recovery Rate	
	Adult		Immature		Adult		Immature			
	1959	1960	1959	1960	1959	1960	1959	1960	1959	1960
Oregon:										
Sauvie Island	222	207	370	594	19.81	17.87	23.78	25.58	1.20	1.43
California:										
Tule Lake NWR	1,142	443	370	288	6.74	7.67	15.94	13.88	2.36	1.81
Montana:										
Medicine Lk. NWR	276	371	(51)	681	6.52	4.85	(11.76)	5.43	(1.80)	1.12
Bowdoin NWR	1,106	454	237	254	3.25	5.37	3.79	3.41	1.17	0.64
North Dakota:										
L. Souris NWR	469	729	(18)	(137)	4.69	7.13	(5.55)	(8.02)	(1.52)	(1.44)
Manitoba:										
Libau Marsh	235	(102)	401	368	7.65	(7.84)	11.47	16.84	1.50	(2.15)
Minnesota:										
Agassiz NWR	335	350	657	730	8.65	8.28	11.11	18.49	1.28	2.23
Rice Lake NWR	392	225	567	477	13.01	10.66	14.46	13.62	1.11	1.28
Michigan:										
Shiawassee NWR	(22)	(93)	347	665	(4.54)	(7.53)	12.10	15.34	(2.67)	(2.04)
New York:										
Perch Lake	(85)	(81)	506	618	(5.88)	(8.64)	11.07	13.75	(1.88)	(1.59)
Perch Lake (Black Duck)[*]	(91)	(96)	626	524	(6.59)	(11.46)	9.90	13.55	(1.50)	(1.18)

** Samples of less than 200 ducks and figures derived from these samples are listed in parentheses.

Table 4. Distribution of Direct Band Recoveries and Relative Recovery Rates by Regions for Black Ducks Banded at Perch Lake, New York (1959 and 1960 Hunting Season Recoveries Combined).

Recovery Area		Adults	Immatures
	Number Banded	187	1,150
Northern Area:			
(N.Y., N.H., Mich., Ont., and Que.)	Number of Recoveries (Per cent of Total)	7 (41%)	104 (78%)
	Recovery Rate in Per cent	3.74	9.04
	Relative Recovery Rate	2.41	
Southern Area:			
(N.J., Pa., Del., Md., Ind., Ky., Va., Tenn., N.C., Ga., Miss., & Fla.)	Number of Recoveries (Per cent of Total)	10 (59%)	29 (22%)
	Recovery Rate in Per cent	5.35	2.52
	Relative Recovery Rate	0.47	

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Table 5. Distribution of Direct Band Recoveries and Relative Recovery Rates by Regions for Mallards Banded at the Medicine Lake National Wildlife Refuge, Montana (1959 and 1960 Hunting Season Recoveries Combined).

Recovery Area		Adults	Immatures
	Number Banded	647	732
Central Flyway	Number of Recoveries (Per cent of Total)	21 (64%)	18 (47%)
	Recovery Rate in Per cent	3.25	2.46
	Relative Recovery Rate	0.76	
Mississippi Flyway	Number of Recoveries (Per cent of Total)	12 (36%)	20 (53%)
	Recovery Rate in Per cent	1.85	2.73
	Relative Recovery Rate	1.48	
Northern Area:			
(Sask., Mont., N.D., S.D., & Wisc.)	Number of Recoveries (Per cent of Total)	11 (33%)	20 (47%)
	Recovery Rate in Per cent	1.70	2.73
	Relative Recovery Rate	1.61	
Southern Area:			
(south of above)	Number of Recoveries (Per cent of Total)	22 (66%)	23 (53%)
	Recovery Rate in Per cent	3.40	3.14
	Relative Recovery Rate	0.92	

Table 6. Distribution of Direct Band Recoveries and Relative Recovery Rates by Regions for Mallards Banded at the Agassiz National Wildlife Refuge, 1959 and 1960.

		1959		1960	
		Adults	Immatures	Adults	Immatures
	Number Banded	335	657	350	730
Northern Recovery Area:	Number of Recoveries (Per cent of total)	16 (55%)	56 (78%)	13 (45%)	107 (79%)
(Minn., Man., N.D., S.D., Wisc., Iowa, & Ont.)	Recovery Rate in Per cent	4.78	8.52	3.71	14.66
	Relative Recovery Rate	1.78		3.95	
Central Recovery Area:	Number of Recoveries (Per cent of total)	4 (14%)	9 (12%)	12 (41%)	15 (11%)
(Ill., Ind., Mo., Ky., and Ohio)	Recovery Rate in Per cent	1.19	1.37	3.43	2.05
	Relative Recovery Rate	1.15		0.60	
Southern Recovery Area:	Number of Recoveries (Per cent of total)	9 (31%)	7 (10%)	4 (14%)	13 (10%)
(Tenn., Ark., La., Miss., Ga., & S.C.)	Recovery Rate in Per cent	2.69	1.06	1.14	1.78
	Relative Recovery Rate	0.39		1.56	

Table 7. Distribution of Direct Band Recoveries and Relative Recovery Rates by Regions for Mallards Banded at the Rice Lake National Wildlife Refuge, 1959 and 1960.

		1959		1960	
		Adults	Immatures	Adults	Immatures
	Number Banded	392	567	225	477
Northern Recovery Area: (Minn., Iowa, Wisc., & Mich.)	Number of Recoveries (Per cent of Total)	33 (67%)	73 (89%)	13 (59%)	41 (65%)
	Recovery Rate in Per cent	8.42	12.87	5.78	8.60
	Relative Recovery Rate	1.53		1.49	
Central Recovery Area:* (Mo., Ill., Ind., Ohio, and Ky.)	Number of Recoveries (Per cent of Total)	8 (16%)	6 (7%)	4 (18%)	14 (22%)
	Recovery Rate in Per cent	2.04	1.06	1.78	2.94
	Relative Recovery Rate	0.52		1.65	
Southern Recovery Area: (Ark., La., Tex. S. C., Ga., & N. Mex.)	Number of Recoveries (Per cent of Total)	8 (16%)	3 (4%)	5 (23%)	8 (13%)
	Recovery Rate in Per cent	2.04	0.53	2.22	1.68
	Relative Recovery Rate	0.26		0.75	

* Recoveries in W. Va., Md., and Va. were excluded.

Table 8. Regional Differences in the Distribution of Direct Recoveries and Relative Recovery Rates of Mallards Banded at the Ninepipe National Wildlife Refuge, Montana (1959 and 1960 Hunting Season Recoveries Combined).[*]

Recovery Area		Adults		Immatures	
	Number Banded	621		615	
Montana	Number of Recoveries (Per cent of Total)	23	(70%)	52	(81%)
	Recovery Rate in Per cent	3.70		8.45	
	Relative Recovery Rate		2.28		
Pacific Flyway: (Wash., Ore., Calif., Utah, & Idaho)	Number of Recoveries (Per cent of Total)	10	(30%)	12	(19%)
	Recovery Rate in Percent	1.61		1.95	
	Relative Recovery Rate		1.21		

[*] All recoveries occurred in either Montana or Pacific Flyway States.

Table 9. Distribution of Direct Band Recoveries and Relative Recovery Rates by Regions for Mallards Banded at Libau, Manitoba (1959 and 1960 Hunting Season Recoveries Combined).

Recovery Area		Adults	Immatures
	Number Banded	337	769
Manitoba:	Number of Recoveries (Per cent of Total)	8 (32%)	64 (59%)
	Recovery Rate in Per cent	2.38	8.32
	Relative Recovery Rate	3.50	
All other States & Provinces:	Number of Recoveries (Per cent of Total)	17 (68%)	44 (41%)
	Recovery Rate in Per cent	5.04	5.72
	Relative Recovery Rate	1.13	

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Table 10. Distribution of Direct Band Recoveries and Relative Recovery Rates by Regions for Mallards Banded at Lower Souris National Wildlife Refuge (1959 and 1960 Direct Recoveries Combined).

Harvest Area		Adults	Immatures
	Number Banded	1,198	155
Canada : (Man. & Sask.)	Number of Recoveries	4	2
	Recovery Rate in Per cent	0.33	1.29
	Relative Recovery Rate	3.91	
North Dakota	Number of Recoveries	18	5
	Recovery Rate in Per cent	1.50	3.23
	Relative Recovery Rate	2.15	
Central Flyway: (Neb., Kan., S.D., & Okla.)	Number of Recoveries	9	1
	Recovery Rate in Per cent	0.75	0.64
	Relative Recovery Rate	0.85	
Miss. & Atl.* Flyways: (Ark., Ill., Iowa, Minn., La., Miss., Mo., Wisc., & Tenn.)	Number of Recoveries	42	4
	Recovery Rate in Per cent	3.51	2.53
	Relative Recovery Rate	0.72	

* Only one recovery from Maryland.

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Table 11. Mallard Direct Recovery Rates and Relative Recovery Rates Based on the Mississippi Flyway Recoveries of Five Banding Stations in 1959 and 1960.

Banding Location	Number Banded				Number Recovered In Miss. Flyway				Miss. Flyway Direct Recovery Rate (Per cent)				Relative Recovery Rate Miss. Flyway	
	Adult		Immature		Adult		Immature		Adult		Immature			
	1959	1960	1959	1960	1959	1960	1959	1960	1959	1960	1959	1960	1959	1960
Manitoba:														
Libau	235	102	401	368	9	4	22	18	3.83	3.92	5.49	4.89	1.43	1.25
Minnesota:														
Agassiz NWR	335	350	657	730	28	26	67	134	8.36	7.43	10.20	18.36	1.22	2.47
Rice Lake NWR	392	225	567	477	48	21	81	61	12.24	9.33	14.29	12.79	1.17	1.37
Montana:														
Medicine Lk. NWR	276	371	51	681	7	7	2	18	2.54	1.89	3.92	2.64	1.54	1.40
North Dakota:														
L. Souris NWR	469	729	18	137	14	27	1	3	2.98	3.70	5.56	2.19	1.87	0.59
Unweighted average													1.45	1.42

Table 12. Estimates of Preseason Mallard Populations Contributing to the Mississippi Flyway Kill Based On Banding, Age Ratios, and Hunting Kill Information.

Information	Source	1959	1960
Mallard Hunting Kill*	Mail Questionnaire Survey	1,279,578	1,548,751
Mallard Age Ratio in Kill (Imm./Adult)	Wing Collection Survey	0.77	1.84
Mallard Hunting Kill:	Mail Questionnaire and Wing Collection Survey		
Adults		722,962	545,160
Immatures		556,616	1,003,591
Direct Band Recovery Rate:	Preseason Banding Table 11.**		
Adults		0.0599	0.0525
Immatures		0.0789	0.0817
Hunting Kill Rate:	Preseason Banding Recovery Rate Adjusted for Non-report of Bands***		
Adults		0.1423	0.1247
Immatures		0.1874	0.1941
Preseason Population Estimate:	Hunting Kill Divided By Rate of Kill		
Adults		5,080,548	4,364,772
Immatures		2,970,202	5,170,479
Total		8,050,750	9,535,251
Kill in Canada not measured by preseason banding in U.S.A.	Explained in text	807,072	955,890
		8,857,822	10,491,141

* Retrieved birds.
**Average recovery rate weighting each banding station equally.
*** Estimated that 42.1% bands taken were reported (Geis and Atwood, 1961).

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